Abstract View

Volume 13, Issue 5 (May 1983)

Journal of Physical Oceanography
Article: pp. 769–782 | Abstract | PDF (978K)

Self-Advection of Density Perturbations on a Sloping Continental Shelf

Ping-Tung Shaw and G.T. Csanady

Woods Hole Oceanographic Institution Woods Hole MA 02543

(Manuscript received October 29, 1982, in final form February 7, 1983)

DOI: 10.1175/1520-0485(1983)013<0769:SAODPO>2.0.CO;2

ABSTRACT

Bottom water movement on the continental shelf is modeled by the nonlinear interaction between long-shore bottom geostrophic flow and the density field. Bottom geostrophic velocity, subject to linear steady momentum equations with linear bottom friction, can be generated by along-isobath density variations over a sloping bottom. At the same time, the density field is slowly advected by the velocity field. Away from boundary layers, the interplay is governed by Burgers' equation, which shows the formation and self-propulsion of strong density gradients along an isobath. The direction of propagation of a dense water blob is to have shallow water on the right- (left-) hand side facing downstream in the Northern (Southern) Hemisphere. The propagation of a light water blob is opposite to that of a dense water blob.

The problem is further investigated by solving the governing equations numerically. Under forcing by localized surface cooling, the flow in the mid-shelf region shows the characteristics of the solution a Burgers' equation. A coastal *buoyancy* source generates a shore-hugging plume, slowly moving along the coast in the direction of Kelvin wave propagation. The flow associated with coastal *dense* water discharge has different characteristics: the dense water moves away from the coast initially. The accumulation of dense water on the mid-shelf then invokes the same self-advection process as found for surface cooling.

The theory sheds light on bottom water movements in the Adriatic Sea over the Antarctic continental shelf, and in the Middle Atlantic Bight. It also describes the dispersion of river water and dense water outflow an the shelf. The model results agree qualitatively with the observed distribution of bottom water and give correct order-of-magnitude estimates for the propagation speed of density perturbations.

top

Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718
Allen Press, Inc. assists in the online publication of *AMS* journals.